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PESTICIDE USE ON GRAIN SORGHUM  
IN THE MAJOR PRODUCING STATES, 1980

by

Iris E. McCalla,  
Craig Osteen, and  
Robert McDowell

February 1982

ERS Staff Report No. AGES820205

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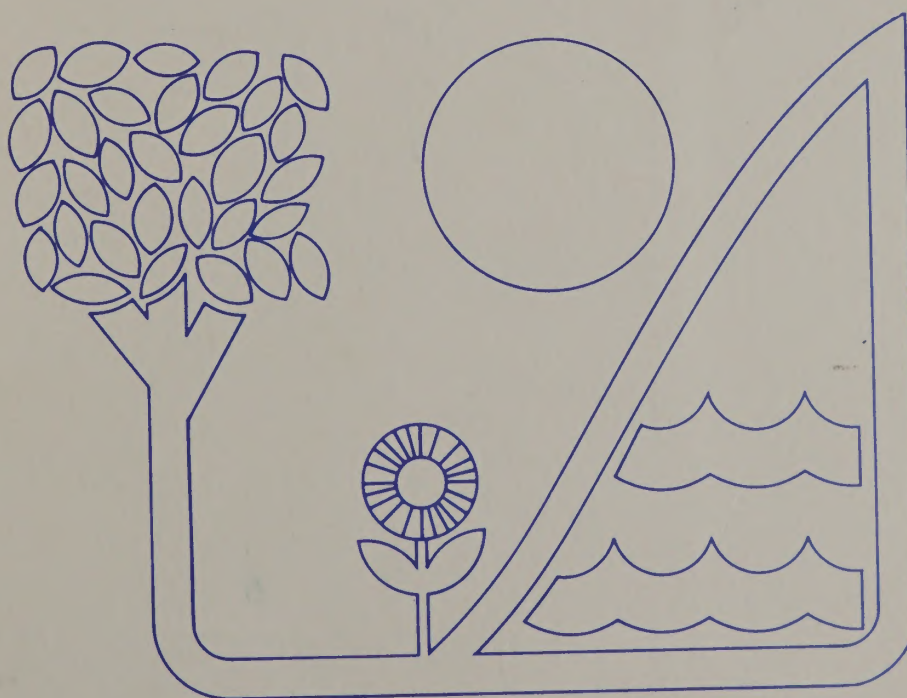
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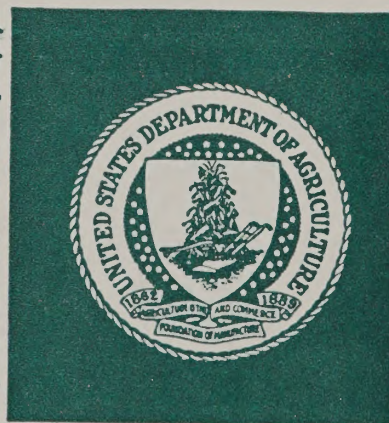




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Natural Resource Economics Division  
Economic Research Service  
U.S. Department of Agriculture  
Washington, D.C. 20250





PESTICIDE USE ON GRAIN SORGHUM IN THE MAJOR PRODUCING STATES, 1980. By Iris E. McCalla, Craig Osteen, and Robert McDowell; Natural Resource Economics Division, Economic Research Service, U.S. Department of Agriculture, Washington, D.C. 20250; February 1982.

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#### ABSTRACT

In 1980, grain sorghum growers in six major producing States applied 14.8 million pounds (active ingredient) of pesticides in 12.2 million acre-treatments. Of the total quantity, 11.8 million pounds were herbicides and 3 million were insecticides. Coefficients of variation were computed for acres treated with specific pesticides and mixes of pesticides.]

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# PESTICIDE USE ON GRAIN SORGHUM IN THE MAJOR PRODUCING STATES, 1980

## INTRODUCTION

This report describes pesticide use on grain sorghum in Kansas, Missouri, Nebraska, Oklahoma, South Dakota, and Texas. Data are presented for quantities of pesticides used, acre-treatments, application rates, and the number of times applied. The data should aid policymakers, researchers, extension specialists, and industry personnel in evaluating pesticide use patterns and the economic impacts of regulatory actions on specific pesticides.

## METHODOLOGY

The Economics and Statistics Service collected pesticide use data in the 1980 Grain Sorghum Pesticide Survey. Enumerators conducted personal interviews under the supervision of the State Statistical Offices. Sample fields were randomly selected from growers who reported through the June Enumerative Survey that they had planted or intended to plant grain sorghum in 1980. Each acre had an equal probability of being selected so that the probability of a field being chosen was directly correlated to its size. Enumerators contacted 700 operators and obtained 524 valid, completed questionnaires. The breakdown by State follows:

<u>State</u>	<u>Sample Drawn</u>	<u>Responses</u>
Kansas	170	117
Missouri	80	70
Nebraska	100	76
Oklahoma	80	62
South Dakota	70	43
Texas	<u>200</u>	<u>156</u>
Total	700	524

The data collected were expanded to estimate pesticide use in the six States. Acres planted with grain sorghum in each State (reported by



the Crop Reporting Board) was divided by the number of valid questionnaires to estimate the expansion factor. The expanded data are reported by region. The Northern Plains includes South Dakota and Nebraska; the Central Plains, Kansas and Missouri; and the Southern Plains, Oklahoma and Texas.

#### RELIABILITY OF ESTIMATES

Estimates based upon sample surveys have varying degrees of statistical reliability. Confidence in data depends upon sample size, sampling methods, and the variability of the responses. To provide the user of the data some indication of the reliability of the estimates, coefficients of variation (CV's) are presented in Appendix Table 1. The CV is a measure of relative variation (expressed in percentage terms) and can be used to indicate the degree of confidence a user can place in the estimate. The larger the CV, the less reliable the estimate.

In simplest terms, it can be said there is a 95 percent confidence that the sample represents the true population and that the true value for the population lies within an interval defined as the estimated value  $\pm 2$  CV's times the estimated value. For example, with a CV of 10 percent and an estimate of 40, the interval would be 32 to 48. However, there is also a 5 percent chance that the true value does not fall within the interval as defined above because the sample is not representative of the population.

CV's were calculated only for acres treated with specific pesticides. The estimates of acres treated are expected to have greater variation than other data reported. Consequently, for most other information included in this report, the level of reliability should be equal to or greater than reported for acres treated.





## DEFINITIONS

In this report the following terms are used:

Active ingredient - The portion of the pesticide product which controls the pest.

Acres treated - The area treated with a pesticide one or more times.

Times applied - The number of times a pesticide material is applied to a given area.

Acre-treatments - The number is determined by multiplying acres treated with a pesticide by the number of times it was applied. Since sorghum growers generally apply a pesticide once per season, the tables showing pesticides and pesticide mixes present acre-treatments but not acres treated.

Herbicides - Chemicals that control weeds.

Insecticides - Chemicals that control insects.

Pesticide mixes - Two or more active ingredients that are formulated together and sold as a product.

Tank-mixes - When growers mix two or more pesticides in the same spray tank and apply them together.

## PESTICIDE USE

### Major Producing States

In 1980, growers in six major sorghum producing States planted 13.9 million acres to sorghum (Table 1). Due to severe drought, they only harvested 11.3 million acres (81 percent) for grain. These growers treated 8.4 million acres (61 percent of planted acres) with herbicides, and 3.3 million acres (24 percent) with insecticides. No fungicide use was reported.

Growers applied 14.8 million pounds of active ingredients (a.i.) of pesticides in 12.2 million acre-treatments (Table 2). They applied 11.8 million





Table 1. Acres planted (all sorghum) and harvested for grain, herbicide and insecticide use by State, 1980

State	: Total acres a/ :		Acres treated b/			
	: : Harvested :		Herbicides		Insecticides	
	: Planted	: for grain	: Total	: Percent c/	: Total	: Percent c/
	-----	<u>1,000</u>	-----		<u>1,000</u>	
Kansas	4,700	3,640	3,173	68	1,470	31
Missouri	1,000	900	733	73	100	10
Nebraska	2,200	2,030	1,915	87	434	20
Oklahoma	700	480	119	17	45	6
South Dakota	485	325	162	33	34	7
Texas	4,800	3,950	2,300	48	1,230	26
Total	13,885	11,325	8,402	61	3,313	24
Other States	2,009	1,397	-	-	-	-
U.S. TOTAL	15,894	12,722	-	-	-	-

a/ "Crop Production-1980 Annual Summary," USDA, ESS, Crop Reporting Board, CrPr 2-1(81), January 4, 1981.

b/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA.

c/ Percent of planted acres.



Table 2. Major producing States: Herbicides and insecticides used on grain sorghum, 1980 a/

Pesticides	: Acre-	: Times	: Pounds of active ingredient	
	: treatments b/	: applied	: Per acre c/	: Total
	<u>1,000</u>	<u>No.</u>		<u>1,000</u>
HERBICIDES				
<u>Single applications</u>				
Atrazine	2,578	1.0	1.4	3,709
Dicamba	199	1.0	.5	92
Glyphosate	110	2.0	1.0	110
Propachlor	407	1.0	2.0	319
Propazine	1,190	1.0	1.1	1,239
Terbutryn	125	1.0	1.4	174
2,4-D	1,077	1.2	.5	571
Other	415	1.1	1.9	770
Total	6,101	-	1.2	7,484
<u>Tank Mixtures</u>				
Atrazine	1,865	1.0	.5	982
+ propachlor			1.1	2,126
Atrazine	377	1.0	1.1	412
+ herbicides			1.1	395
Other	191	-	2.1	400
Total	2,442		1.8	4,315
Total herbicides	8,543	-	1.4	11,799
INSECTICIDES				
<u>Single applications</u>				
Carbaryl	370	1.9	1.1	400
Carbofuran <u>d/</u>	1,046	1.0	.9	927
Chlorpyrifos <u>e/</u>	138	1.0	.2	22
Dimethoate	162	1.1	.4	61
Disulfoton	97	1.0	.9	87
Methomyl	226	1.3	.3	72
Parathion	855	1.0	.5	424
Phorate	164	1.0	.9	142
Propargite	100	1.0	1.4	140
Other	192	1.3	.3	149
Total	3,350	-	.7	2,424

-- continued





Table 2. Major producing States: Herbicides and insecticides used on grain sorghum, 1980 a/ -- continued

Pesticides	: Acre-	: Times	: Pounds of active ingredient	
	: treatments b/	: applied	: Per acre c/	: Total
	<u>1,000</u>	<u>No.</u>		<u>1,000</u>
INSECTICIDES (cont'd)				
<u>Tank Mixtures</u>				
Parathion	166	1.0	.8	132
+ toxaphene			1.8	291
Other	184	1.1	.8	149
Total	350	-	1.6	572
Total insecticides	3,700	-	.8	2,996
TOTAL PESTICIDES	12,243	-	1.2	14,795

a/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA. Includes Kansas, Missouri, Nebraska, Oklahoma, South Dakota, and Texas.

b/ Since sorghum growers generally apply an individual pesticide or tank-mix once per acre treated, acre-treatments are reported but acres treated are not. Acres treated can be computed by dividing acre-treatments by times applied.

c/ Total quantity divided by acre-treatments.

d/ Registered in Kansas, Nebraska, and Texas under Section 24c, Federal Insecticide, Fungicide, and Rodenticide Act.

e/ Registered in Texas under Section 24c, Federal Insecticide, Fungicide, and Rodenticide Act.





pounds of herbicides in 8.5 million acre-treatments. Of these herbicide totals, 7.5 million pounds were applied singly in 6.1 million acre-treatments while 4.3 million pounds (a.i.) were applied as tank-mixes in 2.4 million acre-treatments. Growers also applied 3 million pounds (a.i.) of insecticides in 3.7 million acre-treatments. Of these insecticides, 2.4 million pounds were applied in 3.4 million acre-treatments and 572,000 pounds (a.i.) of insecticide tank-mixes were applied in 350,000 acre-treatments. Growers generally applied herbicides and insecticides once per acre treated.

The three most commonly used herbicides applied singly were atrazine, propazine, and 2,4-D. These materials accounted for 74 percent of the quantity of herbicides applied singly. Atrazine plus propachlor is the most important herbicide tank-mix; it accounted for 76 percent of the acre-treatments of herbicide tank-mixes.

Carbofuran and parathion accounted for 56 percent of the acre-treatments and quantity of insecticides applied singly. Carbaryl and methomyl accounted for an additional 19 percent of the single-ingredient applications. Parathion plus toxaphene was the most commonly used insecticide tank-mix accounting for 47 percent of those acre-treatments.

#### NORTHERN PLAINS

Growers in the Northern Plains planted 2.7 million acres to sorghum and harvested 2.4 million or 89 percent for grain (Table 1). These same growers applied 3.2 million pounds (a.i.) of pesticides in 2.5 million acre-treatments (Table 3). They applied 2.8 million pounds (a.i.) of herbicides (87 percent of total quantity) on 2.1 million acres (77 percent of planted acres). They also applied 412,000 pounds (a.i.) of insecticides (13 percent of total quantity) on 468,000 acres (17 percent of planted acres).



Table 3. Northern Plains: Herbicides and insecticides used on grain sorghum, 1980 a/

Pesticides	: Acre-	: Times	: Pounds of active ingredient	
	: treatments b/	: applied	: Per acre c/	: Total
	<u>1,000</u>	<u>No.</u>		<u>1,000</u>
HERBICIDES				
<u>Single applications</u>				
Atrazine	432	1.0	1.6	678
Propachlor	119	1.0	1.7	206
2,4-D	377	1.0	.3	119
Other	56	1.0	1.4	81
Total	984	1.0	1.1	1,084
<u>Tank Mixtures</u>				
Atrazine	1,029	1.0	.5	490
+ propachlor			1.1	1,065
Other	64	1.0	2.3	144
Total	1,093	-	1.6	1,699
Total herbicides	2,077	-	1.3	2,783
INSECTICIDES				
Carbofuran <u>d/</u>	192	1.0	.9	185
Parathion	111	1.0	.7	73
Phorate	76	1.0	.8	59
Other	89	1.1	1.1	95
Total	468	-	.9	412
TOTAL PESTICIDES	2,545	-	1.3	3,195

a/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA. Includes Nebraska and South Dakota.

b/ Since sorghum growers generally apply an individual pesticide or tank-mix once per acre treated, acre-treatments are reported but acres treated are not. Acres treated can be computed by dividing acre-treatments by times applied.

c/ Total quantity divided by acre-treatments.

d/ Registered in Nebraska under Section 24c, Federal Insecticide, Fungicide, and Rodenticide Act.





Many broadleaf weeds and annual grasses infest grain sorghum. The most commonly used herbicide treatment in the Northern Plains was a tank-mix of atrazine plus propachlor for broad spectrum weed control. This tank-mix was much more important in this region than in the Central or Southern Plains. Growers applied 1.0 million acre-treatments of this tank-mix (50 percent of all herbicide acre-treatments). It accounted for 56 percent of the total quantity (a.i.) of herbicides applied.

In addition, single-ingredient applications of atrazine, propachlor, and 2,4-D are important. Growers applied 678,000 pounds (a.i.) of atrazine in 432,000 acre-treatments, 119,000 pounds of 2,4-D in 377,000 acre-treatments, and 206,000 pounds of propachlor in 119,000 acre-treatments. Atrazine was used to control broadleaf weeds such as morningglory, cocklebur, kochia, pigweed, Russian thistle, smartweed, and velvetleaf. 2,4-D was applied postemergence for broadleaf weed control. Propachlor controlled barnyardgrass, fall panicum, and green and yellow foxtail. Growers applied herbicides, either singly or as tank-mixes, only once per acre treated.

Major insect pests in the Northern Plains include chinch bugs, corn leaf aphids, and greenbugs. The most commonly used insecticides were carbofuran, parathion, and phorate, accounting for 77 percent of the quantity and 81 percent of the acre-treatments of insecticides. They applied 185,000 pounds (a.i.) of carbofuran in 192,000 acres-treatments, 73,000 pounds of parathion in 111,000 acre-treatments, and 59,000 pounds of phorate in 76,000 acre-treatments. Growers generally applied insecticides once per acre treated.

#### CENTRAL PLAINS

Growers in the Central Plains planted 5.7 million acres of grain sorghum; they harvested 4.5 million acres for grain, about 80 percent of those planted



(Table 1). Growers in this region applied 7.7 million pounds (a.i.) of pesticides in 5.6 million acre-treatments (Table 4). Of this pesticide total, they applied 6.1 million pounds (a.i.) of herbicides in 4.0 million acre-treatments and 1.6 million pounds (a.i.) of insecticides in 1.6 million acre-treatments.

Major weed problems in this region include barnyardgrass, giant foxtail, velvetleaf, lambsquarters, pigweed, ragweed, shattercane, and cocklebur. Weeds were controlled primarily with single-ingredient applications. Growers applied 66 percent of the herbicide quantity and 74 percent of the acre-treatments as single ingredients. Atrazine, 2,4-D, and propazine were the most commonly used materials in single ingredient applications. These materials accounted for 43 percent of the quantity of herbicides and 53 percent of the acre-treatments. Atrazine was, by far, the most commonly used herbicide; growers applied 2.1 million pounds (a.i.) in 1.5 million acre-treatments. Growers also applied 418,000 pounds (a.i.) of propazine in 346,000 acre-treatments and 179,000 pounds (a.i.) of 2,4-D in 358,000 acre-treatments. The tank-mix of atrazine plus propachlor was the second most commonly used herbicide treatment, being applied in 790,000 acre-treatments. Growers also applied dicamba, propachlor, and terbutryn accounting for 12 percent of the acre-treatments. They generally applied herbicides once per acre treated.

Important sorghum insect pests in the Central Plains include chinch bugs, greenbugs, corn leaf aphids, cutworms, grasshoppers, and sorghum midges. Mites also can be a problem. The two most commonly used insecticides were carbofuran and dimethoate. Growers applied 679,000 pounds (a.i.) of carbofuran in 744,000 acre-treatments and 88,000 pounds of parathion in 200,000 acre-treatments. Growers also applied a tank-mix of parathion plus toxaphene in 166,000 acre-treatments. To control mites, growers applied 140,000 pounds



Table 4. Central Plains: Herbicides and insecticides used on grain sorghum, 1980 a/

Pesticides	: Acre- : treatments	: Times b/: applied	: Pounds of active ingredient : Per acre c/	: Total
	<u>1,000</u>	<u>No.</u>		<u>1,000</u>
<b>HERBICIDES</b>				
<u>Single applications</u>				
Atrazine	1,453	1.0	1.4	2,052
Dicamba	167	1.0	.5	83
Propachlor	233	1.0	2.3	536
Propazine	346	1.0	1.2	418
Terbutryn	100	1.0	1.3	133
2,4-D	358	1.4	.5	179
Other	321	1.2	2.1	666
Total	2,978	-	1.4	4,067
<u>Tank mixtures</u>				
Atrazine	133	1.1	1.1	137
+ metolachor			1.4	182
Atrazine	790	1.0	.6	455
+ propachlor			1.2	987
Other	132	1.0	2.2	293
Total	1,055	-	1.9	2,054
Total herbicides	4,033	-	1.5	6,121
<b>INSECTICIDES</b>				
<u>Single applications</u>				
Carbofuran <u>d/</u>	744	1.0	.9	679
Dimethoate	85	1.2	.4	31
Parathion	200	1.0	.4	88
Propargite	100	1.0	1.4	140
Other	204	1.0	.9	185
Total	1,333	-	.8	1,123
<u>Tank mixtures</u>				
Parathion	166	1.0	.8	132
+ toxaphene			1.8	291
Other	100	1.0	.8	77
Total	266	1.0	1.9	500
Total insecticides	1,599	-	1.0	1,623
TOTAL PESTICIDES	5,632	-	1.4	7,744

a/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA. Includes Kansas and Missouri.

b/ Since sorghum growers generally apply an individual pesticide or tank-mix once per acre treated, acre-treatments are reported but acres treated are not. Acres treated can be computed by dividing acre-treatments by times applied.

c/ Total quantity divided by acre-treatments.

d/ Registered in Kansas under Section 24c, Federal Insecticide, Fungicide, and Rodenticide Act.





(a.i.) of propargite in 100,000 acre-treatments. Growers generally applied insecticides once per acre treated.

#### SOUTHERN PLAINS

Growers in the Southern Plains planted 5.5 million acres to sorghum and harvested 80 percent (4,430 acres) for grain (Table 1). Sorghum growers applied 3.9 million pounds (a.i.) of pesticides in 4.1 million acre-treatments (Table 5). They applied 2.9 million pounds (a.i.) of herbicides in 2.4 million acre-treatments and 961,000 pounds of insecticides in 1.6 million acre-treatments.

Major weed problems in this region include crabgrass, pigweed, and ragweed. Herbicide tank-mixes were much less important in the Southern Plains than for the other two regions. Growers applied tank-mixes in only 12 percent of the herbicide acre-treatments compared to 53 percent for the Northern Plains and 26 percent for the Central Plains. The most important herbicides were atrazine, propazine, and 2,4-D accounting for 89 percent of the quantity and 88 percent of the acre-treatments of single-ingredient applications. Propazine was the most commonly used in terms of acre-treatments (844,000), but second in terms of total quantity with 821,000 pounds (a.i.). Atrazine was the most commonly used in terms of quantity at 979,000 pounds (a.i.), but second in terms of acre-treatments with 693,000. Atrazine, mixed with other herbicides, was used in 166,000 acre-treatments. Growers also applied 273,000 pounds (a.i.) of 2,4-D in 342,000 acre-treatments.

Important sorghum insect pests in the Southern Plains include greenbugs, chinch bugs, sorghum midges, corn earworms, fall armyworms, and spider mites. The two most commonly used insecticides in the Southern Plains were parathion and carbaryl, accounting for 61 percent of the quantity and 52 percent of the acre-treatments with insecticides. This is a major contrast to the other



Table 5. Southern Plains: Herbicides and insecticides used on grain sorghum, 1980 a/

Pesticides	: Acre-	: Times	: Pounds of active ingredient	
	: treatments b/	: applied	: Per acre c/	: Total
	<u>1,000</u>	<u>No.</u>		<u>1,000</u>
HERBICIDES				
Single applications				
Atrazine	693	1.0	1.4	979
Glyphosate	110	2.0	1.0	110
Propazine	844	1.0	.9	821
2,4-D	342	1.4	.8	273
Other	150	1.0	1.0	150
Total	2,139	-	1.1	2,333
Tank mixtures				
Atrazine	166	1.0	1.1	184
+ herbicides			1.1	180
Other	128	1.0	1.5	198
Total	294	-	1.9	562
Total herbicides	2,433	-	1.2	2,895
INSECTICIDES				
Single applications				
Carbaryl	314	2.0	1.1	326
Carbofuran <u>d/</u>	110	1.0	.6	63
Chlorpyrifos <u>d/</u>	138	1.0	.2	22
Disulfoton	64	1.0	.8	52
Methomyl	193	1.4	.3	57
Parathion	544	1.0	.5	263
Phorate	55	1.0	.7	39
Other	131	1.0	.5	67
Total	1,549	-	.6	889
Tank mixtures				
Parathion	56	1.0	.5	26
+ insecticides			.8	42
Other	28	1.0	.2	4
Total	84		.9	72
Total insecticides	1,633	-	.6	961
TOTAL PESTICIDES	4,066	-	.9	3,856

a/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA. Includes Oklahoma and Texas.

b/ Since sorghum growers generally apply an individual pesticide or tank-mix once per acre treated, acre-treatments are reported but acres treated are not. Acres treated can be computed by dividing acre-treatments by times applied.

c/ Total quantity divided by acre-treatments.

d/ Registered in Texas under Section 24c, Federal Insecticide, Fungicide, and Rodenticide Act.





regions where carbofuran and parathion were the two most important insecticides. Growers in the Southern Plains applied 263,000 pounds (a.i.) of parathion in 544,000 acre-treatments and 326,000 pounds (a.i.) of carbaryl in 314,000 acre-treatments. Carbofuran, chlorpyrifos, and methomyl accounted for an additional 15 percent of the insecticide quantity and 27 percent of the insecticide acre-treatments. Growers generally applied insecticides once per acre treated. However, on the average, carbaryl was applied 2 times and methomyl 1.4 times per acre treated.



Appendix Table 1. Coefficients of variation for acres treated by major active ingredients and tank-mixes, a/ b/

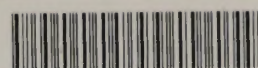
Active ingredient	: Major Producing : : States	Northern : Plains	Central : Plains	Southern : Plains
----- Percent -----				
HERBICIDES				
<u>Single applications</u>				
Atrazine	9	22	11	18
Dicamba	40	-	44	88
Glyphosate	71	-	-	71
Propachlor	24	28	37	71
Propazine	14	-	29	16
Terbutryn	50	- <u>c/</u>	57	-
2,4-D	16	22	34	30
<u>Tank-mixes</u>				
Atrazine + propachlor	9	10	17	63
Atrazine + other	17	78	38	50
INSECTICIDES				
<u>Single applications</u>				
Carbaryl	34	56	- <u>c/</u>	41
Carbofuran	16	36	19	50
Chlorpyrifos	44	-	-	44
Dimethoate	38	82	-	62
Disulfoton	54	-	- <u>c/</u>	44
Methomyl	35	-	- <u>c/</u>	37
Parathion	18	42	40	23
Phorate	41	57	- <u>c/</u>	71
Propargite	57	-	57	-
<u>Tank-mixes</u>				
Parathion + toxaphene	49	-	49	-

a/ 1980 Grain Sorghum Pesticide Survey, Natural Resource Economics Division, ESS, USDA. Includes Kansas, Missouri, Nebraska, Oklahoma, South Dakota, and Texas.

b/ The coefficient of variation is the standard error of the estimate multiplied by 100 and divided by the estimate.

c/ The use of this material was not significant at the regional level and was reported in the "other" category.





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